PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project	
Characterize and quantify residual steelhead in the Clearwater River, Idaho	
BPA project number	9901800
Contract renewal date (mm/yyyy)	To Be Determined
Multiple actions? (indicate Yes or No)	Yes
Business name of agency, institution or organization requesting funding	
U.S. Fish and Wildlife Service, Idaho Fishery Resource Office	
Business acronym (if appropriate)	USFWS, IFRO
Proposal contact person or principal investigator:	
Name	Patricia E. Bigelow
Mailing address	P.O. Box 18
City, ST Zip	Ahsahka, ID 83520
Phone	(208) 476-7242
Fax	(208) 476-7228
Email address	patricia_bigelow@fws.gov
NPPC Program Measure Number(s) which this project addresses	
5.7A.4, 7.2A.6, 7.2D, 7.2D.1, 7.2D.3	
FWS/NMFS Biological Opinion Number(s) which this project addresses	
Endangered Species Act Section 7 Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383, April 5, 1995. Section VIII, Number 1 (page 64), Section X, Numbers 1, 3, and 4 (page 66).	
Other planning document references	
Snake River Salmon Recovery Plan (plan V-4-38) recommends evaluating strategies to reduce residualism, particularly size at release, in steelhead. NMFS' *Status review of west coast steelhead from Washington, Idaho, Oregon, and California* (1996) points out the need for information pertaining to questions addressed by this project: interactions between hatchery and natural stocks within the ESU (page 171), relation between anadromous and non-anadromous forms (possibly residualized) of *Oncorhynchus mykiss* (pages 70, 171). *Wy-Kan-Ush-Mi Wa-Kush-Wit* (Volume I), page 5B-16: "Develop experimental and monitoring programs in association with these projects to study the relationships between natural and supplemented components of populations."	
Short description	
Describe unsuccessful hatchery smolts released into the Clearwater basin. Assess potential negative interactions with wild steelhead produced in the Clearwater basin. Recommend	

modifications to hatchery practices to produce more effective smolts and reduce hatchery/wild interactions.
Target species Steelhead (*Oncorhynchus mykiss*)

Section 2. Sorting and evaluation

Subbasin Clearwater

Evaluation Process Sort

CBFWA caucus		CBFWA eval. process		ISRP project type	
X one or more caucus		If your project fits either of these processes, X one or both		X one or more categories	
X	Anadromous fish	X	Multi-year (milestone-based evaluation)		Watershed councils/model watersheds
	Resident Fish		Watershed project eval.		Information dissemination
	Wildlife				Operation & maintenance
					New construction
				X	Research & monitoring
					Implementation & mgmt
					Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1999	first year; work has not begun yet	

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Estimate emigration success of Dworshak National Fish Hatchery (NFH) smolts	a	PIT tag steelhead smolts, stratified by size, release site, rearing system
		b	Monitor emigration success via PTAGIS database.
2	Estimate number of unsuccessful smolts residing in the Clearwater River (residuals).	a	Multiple sampling of Clearwater mainstem and tributaries
		b	Estimate population using mark/recapture techniques (PIT tags used as mark)
3	Describe residuals.	a	Monitor movement and growth of recaptured steelhead
		b	Determine sex, maturity level, and incidence of piscivory
		c	Determine hatchery, rearing system, release site
		d	Compare characteristics of successful versus unsuccessful smolts (using mark/recapture, PIT tag, and coded-wire tag data)
		e	Assess relation between residualism and hatchery practices. Where possible, recommend changes in hatchery practices to reduce residualism
4	Determine if relations exist between residualism rate, persistence of residuals, and in-river conditions	a	Collect in-river conditions data on water flow and temperature

Obj 1,2,3	Objective	Task a,b,c	Task
		b	Analyze relation of residualism to in-river conditions

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	12/1998	2/2002	Estimate emigration success Dworshak NFH smolts.	X	34.0
2	12/1998	2/2002	Estimate number of unsuccessful smolts residing in the Clearwater River (residuals).	X	33.6
3	4/1999	2/2002	Describe residuals.	X	19.1
4	10/1999	2/2002	Determine relation between residualism rate, persistence of residuals, and in-river conditions.	X	13.3
				Total	100.0

Schedule constraints
NMFS permit will be required, but will be in place from FY 99 activities.
Completion date
FY 2002

Section 5. Budget

FY99 project budget (BPA obligated):	$**133,300**

FY2000 budget by line item

Item	Note	% of total	FY2000 ($)
Personnel	0.5 FTE GS-11 biologist, 0.5 FTE GS-7 biologist, 0.5 FTE GS-5 technician	42.9	36,200
Fringe benefits		7.0	5,900
Supplies, materials, non-expendable property	Coded-wire tag recovery, lab supplies, electrofishing supplies, laptop computer	4.1	3,500

Operations & maintenance	Truck, boat fuel, PIT tagging	4.5	3,800
Capital acquisitions or improvements (e.g. land, buildings, major equip.)			
NEPA costs			
Construction-related support			
PIT tags	# of tags: 6000	20.6	17,400
Travel		0.6	500
Indirect costs	USFWS overhead (34.2%)	20.2	17,065
Subcontractor			
Other			
		TOTAL BPA REQUESTED BUDGET	84,365

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
N/A			
		Total project cost (including BPA portion)	

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	86,000	25,000	N/A	

Section 6. References

Watershed?	Reference
	Arnsberg, B.D., W.P. Connor, and E. Connor. 1992. Mainstem Clearwater River study: assessment for salmonid spawning, incubation, and rearing. Final report to Bonneville Power Administration, Contract DE-A179-87-BP37474, Portland, Oregon.
	Bigelow, P.E. 1995a. Migration to Lower Granite Dam of Dworshak National Fish Hatchery steelhead. Pages 42-58 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. Fisheries Stewardship Project. 1994 Progress Report. U.S. Fish and Wildlife Service and Nez Perce Tribe. U.S. Fish and Wildlife Report, Ahsahka, Idaho.
	Bigelow, P.E. 1995b. Survival to Lower Granite Dam of wild and straying and non-straying Dworshak National Fish Hatchery steelhead. Pages 59-76 *in*

	Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. Fisheries Stewardship Project. 1994 Progress Report. U.S. Fish and Wildlife Service and Nez Perce Tribe. U.S. Fish and Wildlife Report, Ahsahka, Idaho.
	Bigelow, P.E. 1997. Emigration of Dworshak National Fish Hatchery steelhead. Pages III-1 to III-22 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. 1995 Progress Report. U.S. Fish and Wildlife Service and Nez Perce Tribe. Fisheries Stewardship Project. U.S. Fish and Wildlife Service Report. Ahsahka, Idaho
	Bigelow, P.E. and R.S. Bowen. 1997. Emigration of wild A-run and straying Dworshak National Fish Hatchery steelhead. Pages IV-1 to IV-24 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. 1995 Progress Report. Fisheries Stewardship Project. U.S. Fish and Wildlife Service and Nez Perce Tribe, Ahsahka, Idaho..
	Cochnauer, T. 1995. Gas bubble trauma monitoring in the Clearwater River drainage, Idaho, 1995. Report to Bonneville Power Administration and National Marine Fisheries Service, Portland, Idaho. Idaho Department of Fish and Game, Lewiston, Idaho.
	Cochnauer, T. 1996. Gas bubble trauma monitoring in the Clearwater River drainage, Idaho, 1996. Report to Bonneville Power Administration and National Marine Fisheries Service, Portland, Idaho. Idaho Department of Fish and Game, Lewiston, Idaho.
	Cochnauer, T., and S.A. Putnam. 1997. Gas bubble trauma monitoring in the Clearwater River drainage, Idaho, 1997. Report to Bonneville Power Administration and National Marine Fisheries Service, Portland, Idaho. Idaho Department of Fish and Game, Lewiston, Idaho.
	Connor, W.P. 1989. Mainstem Clearwater River study: assessment for salmonid spawning, incubation, and rearing. Annual report to Bonneville Power Administration by the Nez Perce Tribe Department of Fisheries. Contract number DE-AI79-BP37474, Project number 88-15. Portland, Oregon.
	Jonasson, B.C., R.W. Carmichael, and T.A. Whitesel. 1994. Residual hatchery steelhead: characteristics and potential interactions with spring chinook salmon in northeast Oregon. U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Contract number 14-48-0001093538. Oregon Department of Fish and Wildlife, Annual Progress Report, Portland, Oregon.
	Jonasson, B.C., R.W. Carmichael, and T.A. Whitesel. 1995. Residual hatchery steelhead: characteristics and potential interactions with spring chinook salmon in northeast Oregon. U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Contract number 14-48-0001-94543. Oregon Department of Fish and Wildlife, Annual Progress Report, Portland, Oregon.
	Jonasson, B.C., R.W. Carmichael, T.A. Whitesel. 1996. Residual hatchery steelhead: characteristics and potential interactions with spring chinook salmon in northeast Oregon. U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Contract number 14-48-0001-95560. Oregon Department of Fish and Wildlife, Annual Progress Report, Portland, Oregon.
	Parkinson, E.A., J.M. Hume, and Dolighan. 1989. Size and selective predation by rainbow trout on two lacustrine *Oncorhynchus nerka* populations. Fisheries

	Management Report number 94, British Columbia Fisheries Branch, Canada.
	Partridge, F.E. 1985. Effects of steelhead smolt size on residualism and adult return rates. U.S. Fish and Wildlife, Lower Snake River Compensation Plan. Contract number 14-16-001-83605. Idaho Department of Fish and Game, Boise, Idaho.
	Partridge, F.E. 1986. Effects of steelhead smolt size on residualism and adult return rates. U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Contract number 14-16-001-83605. Idaho Department of Fish and Game, Boise, Idaho.
	Rhine, T.D., J.L. Anderson, and R.O. Osborne. 1997. Length of hatchery steelhead smolts released in Idaho with implications to residualism. Idaho Department of Fish and Game, Boise, Idaho.
	Schmitten, R., W. Stelle Jr., and R.P. Jones. 1995. Proposed recovery plan for Snake River salmon. U.S. Department of Commerce. National Oceanic and Atmospheric Administration.
	Schuck, M.L., A.E. Viola, and M.G. Keller. 1995. Lyons Ferry Trout Evaluations Study. U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Contract number 14-16-0001-93540. Washington Department of Fish and Wildlife, 1993-1994 Annual Report, Olympia, Washington.
	Whitesel, T.A., B.C. Jonasson, and R.W. Carmichael. 1993. Residual hatchery steelhead: characteristics and potential interactions with spring chinook salmon in northeast Oregon. U.S. Fish and Wildlife Service, Lower Snake River Compensation Plan. Contract number 14-16-0001-92541. Oregon Department of Fish and Wildlife, Annual Progress Report, Portland, Oregon.

PART II - NARRATIVE

Section 7. Abstract

Region wide there is a growing concern hatchery steelhead may be having negative impacts on wild fish. Specifically, hatchery steelhead failing to emigrate (residuals) may be competing for limited resources with or preying on wild stocks. Yet, little is known about characteristics of residuals. CBFWP specifically indicates the need to evaluate the extent and causes of residualism. This project's goal is to identify practices or characteristics leading to increased residualism. Specific objectives include characterizing successful smolts, residuals, and comparing differences. We will also estimate the number of residuals in the lower Clearwater River. Sampling will be done by electrofishing. By sampling areas of the mainstem Clearwater and its tributaries for coded-wire tagged residuals (10% of production), we will obtain information on hatchery, rearing system, release site, sex, maturity, and piscivory of steelhead which fail to emigrate. By PIT tagging all unmarked steelhead and utilizing mark/recapture techniques, we will estimate numbers and growth rates of residuals in the basin below Dworshak NFH. Length, weight, and emigration history will be obtained from all steelhead captured and released. Differences in hatchery practices (release size, release site, rearing system, hatchery) will be tested using a chi-square statistic. Growth rates of emigrants and residuals will be compared by ANOVA. Other residual

characteristics will be descriptive. Expected results include information leading to production of more effective hatchery smolts, maximizing our hatchery program and minimizing negative impacts to the threatened wild steelhead and fall chinook stocks in the basin. We also expect to determine if unsuccessful smolts are residing in the Clearwater River or simply expiring after their release to the wild.

Section 8. Project description

a. Technical and/or scientific background

The B-run steelhead program at Dworshak National Fish Hatchery (NFH) mitigates for spawning habitat lost when the completion of Dworshak Dam in 1973 denied access to this run's historic spawning grounds. This genetically unique steelhead is maintained by Dworshak NFH by releasing over two million smolts annually. Gametes from returning adults are provided to Clearwater Hatchery which releases over .5 million steelhead annually in the upper portions of the Clearwater basin. In many years, a high percentage of hatchery smolts never arrive at Lower Granite Dam 116 km downstream of the hatchery (Bigelow 1995a, Bigelow 1997). Some of these non-migrating B-run fish, termed residuals, have been found in tributaries cohabitating with wild A-run steelhead (Connor 1989, Bigelow 1995b, Bigelow and Bowen 1997). Residuals have also been found in the Clearwater River mainstem throughout the summer (Arnsberg et al. 1992, Cochnauer 1995, Cochnauer 1996, Cochnauer and Putnam 1997).

In order to operate the most effective hatchery program possible we need to closely evaluate hatchery practices. Proper size at release for steelhead smolts is an issue which has been debated by several management agencies recently (Schmitten et al. 1995, Rhine et al. 1997). Previous work has demonstrated that smaller fish in a hatchery cohort have a greater tendency to residualize than the general population (Whitesel et al. 1993, Jonasson et al. 1994, Bigelow 1995a, Jonasson et al. 1995, Schuck et al. 1995, Bigelow 1997). What is not known is the optimum size at release to minimize residualism. Residualism rate may also increase if release size is too large (Partridge 1985, Partridge 1986). Larger residuals have a greater potential to prey on other listed stocks (Parkinson et al. 1989, Jonasson et al. 1996).

Effects of release sites and rearing systems also need to be evaluated. Although most Dworshak NFH steelhead are released directly into the Clearwater River, a little less than half are released at several sites upstream from the hatchery. The intent of this strategy is to distribute the adult fishery over a larger stretch of the river. At Dworshak NFH, steelhead are reared in 3 different systems. System I is supplied with ambient temperature water from the North Fork Clearwater River. Systems II and III are also supplied with river water but are designed so that effluent water can be reconditioned, heated, and recirculated. 'Reused' water is mixed with fresh water and returned to the ponds. Warmer water temperatures in systems II and III are used to speed growth of steelhead.

Also unknown are the impacts our hatchery programs may be having on listed species in the basin. Snake River fall chinook, steelhead, and bull trout are listed as threatened under the Endangered Species Act. Ten tributaries of the lower Clearwater River produce wild steelhead. Snake River fall chinook has also been documented spawning in the lower Clearwater River (Arnsberg et al.

1992). Effects of straying and residualizing juveniles released from the hatchery thus far have not been adequately evaluated. Although likely insignificant in northeast Oregon, Jonasson et al. (1996), did find larger residuals do prey on both juvenile chinook and steelhead. Data characterizing unsuccessful smolts will enable us to modify hatchery practices, such as size at release, rearing system, or release site, to rear a more effective smolt and reduce any negative interaction with wild steelhead and chinook which may be occurring.

b. Rationale and significance to Regional Programs

The Columbia Basin Fish and Wildlife Program relies heavily on hatchery production. There is a strong need to examine hatchery programs to ensure we are not causing more harm than good in areas where both wild and hatchery production of anadromous stocks occurs. Residualism of hatchery steelhead potentially causes two problems: first, where wild production occurs, negative impacts to the wild stocks could be occurring (e.g. competition, displacement, and predation); and second, producing unsuccessful smolts in the hatchery contributes nothing to the fishery or health of the stock and is a waste of resources. With this project, we hope to quantify the extent of residualism (and therefore, potential impacts) and characterize the steelhead which are residualizing (leading to modification of hatchery practices to reduce residualism). Following are specific references to the need for obtaining more information on residualizing hatchery steelhead, interactions between hatchery and wild steelhead, and improving hatchery practices.

Columbia River Basin Fish and Wildlife Program

> 5.7A.4—"Evaluate the extent of residualism (precocious males) in hatchery steelhead populations. Determine the causes of residualism in hatchery steelhead populations and initiate actions, based upon the results of these determinations, to reduce the incidence or residualism by at least 50 percent to reduce the potential for residual hatchery steelhead to prey on or compete with natural salmon/steelhead populations." Our project directly evaluates the extent of residualism occurring in the lower Clearwater River and its tributaries and attempts to determine hatchery practices contributing to residualism. We will also be documenting predation on other salmonids in the basin (Objectives 1, 2, and 3).
>
> 7.2A.6—"Ecological interactions policy: Hatchery facilities and programs should avoid adverse interactions between wild, natural and hatchery fish populations, including predation, displacement or competition for habitat." Our project will document the extent of potential interactions between hatchery-reared and wild steelhead in the lower Clearwater River (Objectives 1 and 2).
>
> 7.2D—Our data on emigration success and residualism rate will be correlated with in-river conditions such as water temperature and flow (Objective 4).
>
> 7.2D.1—"Fund research, development and demonstration of improved husbandry practices at hatcheries, which will lead to increased production and improved fish survival to adulthood." Results from our research will allow modification of hatchery practices to rear a more effective smolt, thus increasing survival to adulthood.

7.2D.3—"Fund research, development and testing of hatchery rearing operations and release strategies aimed at improving the efficiency of hatcheries and increasing the survival of artificially propagated fish to adulthood." We will be testing effects of size at release, release site, and rearing system on the emigration success and residualism rate (Objective 1).

NMFS' Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383, April 5, 1995:

Section VIII, Number 1: "Restricting lengths of hatchery steelhead released in the Snake River basin is listed as a reasonable and prudent alternative to reduce predation on and competition with listed stocks." This project will directly address the question of optimum size at release with respect to maximizing emigration and minimizing residualism (and therefore competition and predation). We will document numbers and length of hatchery steelhead which residualize.

Section X, Numbers 1, 3, and 4: Conservation recommendations listed under numbers 1, 3, and 4 will all be addressed by this project. Other hatchery practices besides size at release which will be directly evaluated are rearing system and release site. We will examine stomachs of all sacrificed residual steelhead for evidence of predation.

Snake River Salmon Recovery Plan (page V-4-38) recommends evaluating strategies to reduce residualism, particularly size at release, in steelhead. This project directly evaluates size at release, rearing system, and release site strategies with the purpose of evaluating emigration success and effects on residualism.

NMFS' *Status review of west coast steelhead from Washington, Idaho, Oregon, and California* (1996) points out the need for information pertaining to questions addressed by this project. Interactions between hatchery and natural stocks within the ESU (page 171) will be addressed by documenting the extent of residualism occurring, characterizing the steelhead residualizing, and recommending practices to limit residualism, and therefore interactions, of hatchery steelhead. This project will also contribute to the knowledge base of the relation between anadromous and non-anadromous forms (possibly residualized) of *Oncorhynchus mykiss* (pages 70, 171).

Wy-Kan-Ush-Mi Wa-Kush-Wit relies heavily on hatchery programs to restore fisheries to the Snake River Basin. Included in their plan is increased hatchery steelhead production in the Clearwater Basin. In reference to hatchery production, *Wy-Kan-Ush-Mi Wa-Kush-Wit* (Volume I), page 5B-16, states: "Develop experimental and monitoring programs in association with these projects to study the relationships between natural and supplemented components of populations." Our project will contribute to the understanding of the relation between natural and 'supplemented' populations. It will also aid in understanding effects of hatchery practices on emigration success.

c. Relationships to other projects

This project will address questions raised by work conducted by the U.S. Fish and Wildlife Service and Nez Perce Tribe in the Clearwater Basin (cited above as: Bigelow 1995a, Bigelow 1995b, Bigelow 1997, Bigelow and Bowen 1997). If this project is conducted, additional data can be collected by coordinating with Idaho Department of Fish and Game's BPA Project *Gas bubble trauma monitoring in the Clearwater River drainage, Idaho.* All coded-wire tagged hatchery steelhead sampled for gas bubble trauma would be sacrificed to gain additional samples for our characterization of hatchery steelhead which tend to residualize.

The project would also complement information gathered by Oregon Department of Fish and Wildlife (cited above as Whitesel et al. 1993, Jonasson et al. 1994, and Jonasson et al. 1995) on residual hatchery steelhead and potential impacts to spring chinook salmon in the Grande Ronde and Imnaha basins.

Another project proposed by this office for FY 2000, *Evaluate Feeding Strategies to Reduce Residualism and Promote Smolting of Dworshak Juvenile Steelhead in the Clearwater River in Idaho*, has very similar objectives, but is approaching the problem from a different angle. Rather than manipulating size at release as an experimental variable, this project proposes to alter growth rate. Field sampling for this project consists of sampling efforts on emigrating steelhead as they move through the hydrosystem. Our project will be able to collect additional data on their steelhead which are not emigrating downstream.

d. Project history (for ongoing projects)

N/A (This project received initial funding during FY99 and has not begun yet.)

e. Proposal objectives

Our objectives are to:

1. Estimate emigration success of Dworshak National Fish Hatchery steelhead smolts, evaluated by size at release, release site, and rearing system.
2. Estimate number of unsuccessful smolts residing in the Clearwater Basin throughout the summer.
3. Describe hatchery-reared steelhead which are residualizing in the basin, by size, sex, sexual maturity, and relevant hatchery practices (e.g. release site, rearing system, release size, health history).

Annual reports, summarizing emigration success, estimate of residualism rate throughout the summer, and characteristics of residualized steelhead, will be produced. A final project report will summarize these data over the three year period and include a fourth objective:

4. Determine if a relation exists between in-river conditions (flow and temperature) to emigration success, residualism rate, and persistence of residual steelhead over time.

The proposed study will test these null hypotheses:

- Dworshak NFH B-run steelhead residualism rate is not related to hatchery

practices such as size at release, release site, or rearing system;
- Steelhead residualism in the Clearwater River is not related to sex or maturity; and
- Dworshak NFH B-run steelhead residualism rate is not related to mainstem Clearwater River or tributary discharge or temperature during the migration period.

f. Methods

Critical assumptions.—Coded-wire tagged steelhead do not perform differently than non-coded-wire tagged steelhead. PIT tagging steelhead does not effect their behavior or performance. Electrofishing will yield adequate recaptures for a Jolly-Seber estimate. However, if this assumption is not met each year, we will still have valuable trend data.

Sampling.—Sampling and data collection will be conducted on four levels: at the hatchery prior to steelhead releases, in the mainstem Clearwater River beginning just prior to hatchery releases and continuing throughout the summer (April through August), in tributaries downstream of release sites beginning just prior to hatchery releases and continuing until stream water temperatures increase beyond safe salmonid handling conditions (likely April through June), and at dams with juvenile detection facilities (Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville). Emigration and growth (of subsampled fish) will be monitored through the PTAGIS database information system. Field sampling will be conducted bi-weekly and no sampling will be done during hatchery releases or the following week.

Approximately 4,000 steelhead, stratified by size at release, release site, and rearing system, will be sampled at the hatchery. Each strata will contain 2 to 3 raceways for replication and within each raceway, 300 representative steelhead will be sampled. Sample sizes were determined by the size variation existing within ponds. Each steelhead will be PIT tagged. Length will be measured on all steelhead and weight will be measured on a subsample of these steelhead. Precociousness will be noted. We expect very few of these fish will be resampled in the mainstem or tributary sampling. They will, however, provide excellent information on emigration success and timing based on the stratified factors as they emigrate downstream.

Electrofishing will be employed to sample steelhead on the mainstem Clearwater River. Approximately 10% of all hatchery-released steelhead receive coded-wire tags. Steelhead collected which are coded-wire tagged will be sacrificed to determine hatchery rearing container, sex, and maturity level. Stomach contents will be examined to determine piscivory. Length data will also be obtained from these fish. Based on sampling results by Cochnauer (1995, 1996), we expect to capture between 100 and 300 coded-wire tagged steelhead each season. These fish will provide detailed data on rearing system, egg take, fish health treatments, release site, and target release size.

Although we expect the majority of residuals in this stretch of river will have originated from Dworshak NFH, it is possible some could have originated from Clearwater Fish Hatchery. Clearwater Fish Hatchery annually releases steelhead into headwater areas of the Clearwater River. We expect residuals from these releases to be farther upstream and not sampled significantly in this study. Approximately 10% of these steelhead are also coded-wire tagged and by sacrificing all coded-wire tagged steelhead, we will be able to determine the percent of

residuals from each hatchery.

All steelhead captured without a coded-wire tag will be measured for length and precociousness and checked for a PIT tag. Those not already PIT tagged will be PIT tagged. All of these steelhead will be released. Recaptured steelhead will provide population and growth data for those fish residing in the mainstem.

Tributaries will also be sampled using electrofishing. Steelhead captured in the tributaries will be handled the same as those captured in the mainstem. We expect to capture an additional 30 to 50 coded-wire tagged steelhead during tributary sampling. If time permits, range of residuals up tributaries will be documented.

Snorkeling may be used at selected sites to verify electrofishing distribution data.

Analysis.—Chi-square tests will be used to test emigration success and residualism rate of hatchery steelhead based on rearing system, size at release, and release site. Growth rates of wild, residual, and emigrating steelhead will be compared using ANOVA. Descriptive characteristics of residuals will include sex, maturity, and piscivory.

The open population Jolly-Seber method will be used to estimate the number of residuals in the lower Clearwater River.

In-river conditions, including flow and temperature in the Clearwater River, will be correlated with residual rates and emigration success based on the stratifying factors over the three year period.

Expected results.—We expect to determine if hatchery practices such as size at release, release site, and rearing system can be modified to reduce the number of residuals produced and improve emigration success. We expect to determine whether the majority of hatchery steelhead not successfully emigrating are residing in the Clearwater Basin or simply not surviving their release to the wild. We also expect to determine characteristics (sex, length, maturity, or pertinent hatchery practices) which tend to be exhibited by hatchery steelhead which residualize.

g. Facilities and equipment

The Idaho Fishery Resource Office is a very well equipped field office for the U.S. Fish and Wildlife Service. We have adequate personnel, office support, computers, PIT-tagging and reading equipment and facilities, field sampling gear (including back-pack shockers, snorkel equipment, trucks, and a state-of-the-art electrofishing boat to be purchased during FY1999) to complete this project.

h. Budget

The requested budget for FY2000 is much lower than that of FY1999 because of the purchase of an electrofishing boat in FY1999. Personnel costs have been adjusted upward for anticipated cost of living increases. Supplies and materials include the cost of upgrading our computer to handle changes associated with switching to the new PIT tags. Operation and maintenance includes

gasoline to run the truck, boat, and electrofishing gear. Also included is the price of handling and PIT tagging fish. Our office estimates a cost of $0.55 per fish. The amount of PIT tags requested is based on the experimental design of 2 release sizes, 3 release sites, 3 rearing systems, in-river sampling, and in-tributary sampling. Travel for this project should be minimal because no over night trips are required during field sampling. However, it is expected that at least one or two trips to professional meetings will be necessary in order to present information obtained. Indirect costs include overhead determined by our regional and Washington offices (34.2%).

Section 9. Key personnel

Principle Investigator: Patricia E. Bigelow, Fishery Biologist, GS-11

Project duties: Oversee field data collection, ensure proper PIT tagging of steelhead, analyze and report data and findings.

Qualifications: Fifteen years of field experience in fisheries biology/ management, including five years in the Clearwater Basin
(Resume included)

Section 10. Information/technology transfer

Results will be disseminated annually via interim project reports. A final report, tying together all aspects of the project, will be produced after three years of data collection. Pertinent information on successful smolts, hatchery practices, and steelhead release information will be submitted to appropriate peer-reviewed journals for wider circulation.

Congratulations!

Patricia E. Bigelow

EDUCATION

Master of Science—MONTANA STATE UNIVERSITY **1991**
Major: Fish and Wildlife Management BOZEMAN, MONTANA
Bachelor of Science—COLORADO STATE UNIVERSITY **1985**
Major: Fishery Biology *Minor:* Computer Science FORT COLLINS, COLORADO

EMPLOYMENT

Fishery Biologist **1994-Present**
U.S. FISH AND WILDLIFE SERVICE AHSAHKA, IDAHO

Investigate hatchery/wild interactions of steelhead in the Clearwater Basin. Work with Dworshak and Hagerman national fish hatcheries to evaluate products and successfulness of the program. Coordination Act Report for impacts of removal of four Lower Snake River dams on resident fish.

Fishery Biologist **1991-1994**
U.S. FISH AND WILDLIFE SERVICE RED BLUFF, CALIFORNIA

Evaluate effectiveness of spawning gravel restoration project for winter, spring, fall, and late fall chinook in the Sacramento River. Conduct chinook redd surveys using aerial and SCUBA techniques.

Fishery Biologist **1989-1991**
U.S. FISH AND WILDLIFE SERVICE OLYMPIA, WASHINGTON

Investigate hatchery/wild interactions of coho by conducting density estimates in supplemented and unsupplemented creeks in the Queets River basin. Monitor movements of spring chinook salmon to determine spawning habitat and timing. Work with Quinault, Quilcene, and Makah national fish hatcheries to evaluate products and successfulness of programs. Develop software for fast and easy retrieval of summarized information from coast wide escapement database.

Fishery Biologist **1987-1989**
CONTRACTED BY UNIVERSITY OF WYOMING BOZEMAN, MONTANA

Evaluate potential of scale pattern analysis to differentiate between groups of hatchery trout. Scale patterns were manipulated using varying feed and water temperature regimes.

EXPERTISE—Bigelow has worked over twelve years as a fishery biologist plus several years as a fisheries technician in several field office. She has worked with steelhead in the Clearwater Basin since June, 1994 and has experience assisting hatchery personnel evaluate their programs at several hatcheries. She has an excellent knowledge of statistical procedures needed for proper data analysis and has been certified by the U.S. Fish and Wildlife Service to safely and properly operate boats and electrofishing equipment.

SELECTED REPORTS

Bigelow, P.E. 1995. Migration to Lower Granite Dam of Dworshak National Fish Hatchery steelhead. Pages 42-58 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. 1994 Progress Report. Fisheries Stewardship Project. U.S. Fish and Wildlife Service and Nez Perce Tribe, Ahsahka, Idaho.

Bigelow, P.E. 1995. Survival to Lower Granite Dam of wild and straying and non-straying Dworshak National Fish Hatchery steelhead. Pages 59-76 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. 1994 Progress Report. Fisheries Stewardship Project. U.S. Fish and Wildlife Service and Nez Perce Tribe, Ahsahka, Idaho.

Bigelow, P.E. 1997. Emigration of Dworshak National Fish Hatchery steelhead. Pages III-1 to III-22 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. 1995 Progress Report. Fisheries Stewardship Project. U.S. Fish and Wildlife Service and Nez Perce Tribe, Ahsahka, Idaho.

Bigelow, P.E. and R.S. Bowen. 1997. Emigration of wild A-run and straying Dworshak National Fish Hatchery steelhead. Pages IV-1 to IV-24 *in* Interactions of hatchery and wild steelhead in the Clearwater River of Idaho. 1995 Progress Report. Fisheries Stewardship Project. U.S. Fish and Wildlife Service and Nez Perce Tribe, Ahsahka, Idaho.